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PROCEDURES FOR ESTIMATING DRY WEATHER
POLLUTANT DEPOSITION IN SEWERAGE SYSTEMS

by

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FOREWORD

The Environmental Protection Agency was created because of increasing public and government concern about the dangers of pollution to the health and welfare of the American people. Noxious air, foul water, and spoiled land are tragic testimony to the deterioration of our natural environment. The complexity of that environment and the interplay between its components require a concentrated and integrated attack on the problem.

Research and development is that necessary first step in problem solution and it involves defining the problem, measuring its impact, and searching for solutions. The Municipal Environmental Research Laboratory develops new and improved technology and systems for the prevention, treatment, and management of wastewater and solid and hazardous waste pollutant discharges from municipal and community sources, for the preservation and treatment for public drinking water supplies and to minimize the adverse economic, social, health, and aesthetic effects of pollution. This publication is one of the products of that research, a most vital communications link between the researcher and the user community.

The deleterious effects of storm sewer discharges and combined sewer overflows upon the nation's waterways have become of increasing concern in recent times. Efforts to alleviate the problem depend in part upon the development of improved flow attenuation and treatment devices.

This report presents a series of generalized predictive approaches for estimating the amount of sewage solids and other pollutants that deposit in sewerage systems during dry weather conditions. These procedures are intended to provide estimates of overall pollutant deposition for entire sewer collection systems.

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ABSTRACT

A set of generalized procedures for estimating pollutant loadings associated with dry weather sewage solids deposition in combined sewer systems has been prepared to provide planners, engineers and municipal managers with technical information so that they can make intelligent informed decisions on potential sewer flushing programs in combination with other combined sewer management controls.

The predictive equations relate the total daily mass of pollutant deposition accumulations within a collection system to physical characteristics of collection systems such as per capita waste rate, service area, total pipe length, average pipe slope, average diameter and other more complicated parameters that derive from analysis of pipe slope characteristics. Several alternative predictive models are presented reflecting anticipated differences in the availability of data and user resources. Pollutant parameters include suspended solids, volatile suspended solids, biochemical oxygen demand, chemical oxygen demand, total organic nitrogen and total phosphorous. Sewer system age and degree of maintenance was also considered. Factors are presented for estimating the increase in collection system deposition resulting from improper maintenance. A user's guide has been presented to establish the necessary data input to utilize the predictive procedures.

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LIST OF ABBREVIATIONS AND SYMBOLS

ABBREVIATIONS

CDF	- cumulative distribution function
ft	- foot
gpcd	- gallons per capit per day
kg	- kilogram
lb/day	- pounds/day
log	- logarithm
mi	- mile
WRNDB	- sewerage system within the area covering portions of West Roxbury, Dedham, Newton and Brookline in metropolitan Boston.

SYMBOLS

A	- Area of collection system (acres)	FS	- Indicates the cumulative probability of a value s of the pipe slopes
AV	- Indicates a variable in the regression analysis which is available to enter the regression equation	GS	- Indicates complementary cumulative probability distribution
BOD	- Biochemical Oxygen Demand (5 day)	L	- Total length of the collection system (ft)
COD	- Chemical Oxygen Demand	li	- Length of sewer segment i
\bar{D}	- Mean pipe diameter of a collection system, (in)	LPD	- Length of pipe over which 80% of the total loads deposit in the collection system
D_i	- Pipe diameter of sewer segment i, (in)	LPM	- Estimated length of pipe over which the percentage PM of the total loads deposit in the collection system
DP	- Indicates the dependent variable in the regression analysis	n	- The total number of pipe segments in a collection system
e	- Base of the natural logarithms;	NH ₃	- Ammonia
FI	- Indicates a variable in the regression analysis to be forced in the regression equation	p	- Particle size (mm)
FO	- Indicates a variable in the regression analysis to be kept out of the regression equation.	P	- Total Phosphorous
		P(a)	- Indicates the probability of a

PL	- Percentage of pipe length corresponding to a percentage of PM of the loads depositing in the collection system	\bar{SPD}	- Average of pipe slopes below SPD in the CDF
PLD	- Percentage of pipe length corresponding to 80% of the loads depositing in the collection system	SPD/4	- One fourth of SPD
PLD/4	- One fourth of PLD	SPL	- Slope corresponding to PL in the CDF of the pipe slopes
PM	- Any given percentage of the solids deposited in a collection system	TKN	- Total Kjeldhal Nitrogen
PP	- population in service area	TS	- Indicates the total mass of solids that deposit in the system (lb/day)
q	- Discharge per capita, including infiltration, (gpcd)	TSa-b	- Indicates the total mass of solids that deposit in the collection system, assuming pipe bottom sediment varying from a to b (inches)
QAV	- Average daily dry weather flow, (cfs)	TS	- Total Suspended Solids
QMAX	- Peak daily dry weather flow (cfs)	VSS	- Volatile Suspended Solids
r	- hydraulic radius (ft)	X	- Major dimension of non-circular pipe
R	- Multiple regression coefficient in the regression analysis	Y	- Minor dimensions of non-circular pipe
R ²	- Portion of the total variation about the mean (predicted by the regression equation) which is explained by the regression	Z _i	- Percentage daily solids deposition rate in pipe segment i
\bar{S}	- Mean pipe slope of the collection system	ZS _i	- Amount of daily dry weather sewage solids input along pipe segment i
s	- A particular value of pipe slope	ρ	- specific weight of water
ss	- Energy slope	τ	- Fluid shear stress
S _i	- Slope of sewer segment i	τ_c	- Critical shear stress
SG	- Mean ground slope		
SPD	- Slope corresponding to PLD in the CDF of the pipe slopes		

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